

What is claimed:

1. A substrate centering apparatus comprising:
 - a chamber body having a bottom;
 - a vertically moveable substrate support disposed in the chamber body and having a first side adapted to support a substrate during processing;
 - at least three elements movably coupled to the substrate support in a spaced-apart relation proximate a perimeter of the substrate support;
 - a first end of each element extending beyond the first side of the substrate support, the first end adapted to engage an edge of the substrate; and
 - a second end of each element positioned below a second side of the substrate support and adapted to engage the bottom of the chamber body when the substrate is in a lowered position.
2. The processing chamber of claim 1, wherein the substrate support further comprises at least three apertures adapted to receive the at least three elements therethrough.
3. The processing chamber of claim 2, wherein the at least three apertures disposed through the substrate support are sized to accommodate a pre-defined radial displacement of the at least three elements.
4. The processing chamber of claim 1, wherein the first ends of the at least three elements are adapted to be displaced radially relative to a center of the substrate support when the substrate support moves between a raised position and a lowered position.
5. The processing chamber of claim 4, wherein each of the at least three elements is adapted to rotate about an axis substantially parallel to a plane of the substrate support.

6. The processing chamber of claim 4, wherein each of the at least three elements is adapted to slide linearly along an axis substantially parallel to a plane of the substrate support.
7. The processing chamber of claim 6, further comprising:
 - at least three rails disposed on the second side of the substrate support, said rails extending along at least a portion of a radius of the substrate support; and
 - at least three linear slides adapted to slidably engage the at least three rails, each of the at least three linear slides being coupled to one of the at least three elements.
8. The processing chamber of claim 1, wherein the second ends of each of the at least three elements further comprises a roller.
9. The processing chamber of claim 1, wherein the second ends of each of the at least three elements further comprises a radius or fillet.
10. The processing chamber of claim 1, further comprising at least three biasing members adapted for biasing the at least three elements radially inward relative to the substrate support.
11. The processing chamber of claim 10, wherein the at least three biasing members are torsion springs disposed around pins coupling the at least three elements to the substrate support.
12. The processing chamber of claim 10, wherein the at least three biasing members comprise at least one of a compression spring or solenoid.
13. The processing chamber of claim 1, further comprising:
 - a ramp coupled to the bottom of the chamber body, the ramp being adapted to engage the second ends of the at least three elements to urge the

first ends of the at least three elements radially outward relative to a center of the substrate support.

14. The processing chamber of claim 1, further comprising:

a plurality of lift pin holes disposed through the substrate support, said lift pins holes being positioned radially inward of the at least three elements;

a plurality of lift pins disposed through the plurality of lift pin holes, each lift pin comprising a first end adapted for supporting a substrate thereon and a second end extending below the second side of the substrate support; and

a lift plate positioned beneath and substantially parallel to the substrate support, adapted for contacting the second ends of the plurality of lift pins and urging the plurality of lift pins upward through the plurality of lift pin holes in the substrate support.

15. The processing chamber of claim 14, wherein the lift plate is adapted to allow the second ends of the at least three elements to pass therethrough.

16. The processing chamber of claim 15, wherein the lift plate further comprises:

at least three apertures, wherein each aperture is positioned substantially beneath one of the at least three elements.

17. The processing chamber of claim 15, wherein the lift plate further comprises:

at least three slots, wherein each slot is positioned substantially beneath one of the at least three elements.

18. The processing chamber of claim 1, wherein the at least three elements are at least three levers adapted to contact an edge of the substrate.

19. A substrate centering apparatus comprising:

a chamber body having a bottom;

a vertically moveable substrate support disposed in the chamber body and having a first side adapted to support a substrate during processing;
at least three levers movably coupled to the substrate support in a spaced-apart relation proximate a perimeter of the substrate support;

a first end of each lever extending beyond the first side of the substrate support, the first end adapted to engage an edge of the substrate and adapted to be displaced radially relative to a center of the substrate support when the substrate support moves between a raised position and a lowered position;

a second end of each lever positioned below a second side of the substrate support and adapted to engage the bottom of the chamber body when the substrate is in a lowered position, the second end comprising a radius or fillet;

a plurality of lift pin holes disposed through the substrate support, said lift pins holes being positioned radially inward of the at least three levers;

a plurality of lift pins disposed through the plurality of lift pin holes, each lift pin comprising a first end adapted for supporting a substrate thereon and a second end extending below the second side of the substrate support; and

a lift plate positioned beneath and substantially parallel to the substrate support, adapted for contacting the second ends of the plurality of lift pins and urging the plurality of lift pins upward through the plurality of lift pin holes in the substrate support, wherein the lift plate comprises at least three apertures, each aperture positioned substantially beneath one of the at least three levers, to allow the second ends of the at least three levers to pass therethrough.

20. A substrate centering apparatus comprising:

a chamber body having a bottom;

a vertically moveable substrate support disposed in the chamber body and having a first side adapted to support a substrate during processing;

at least three levers movably coupled to the substrate support in a spaced-apart relation proximate a perimeter of the substrate support;

a first end of each lever extending beyond the first side of the substrate support, the first end adapted to engage an edge of the substrate and adapted

to be displaced radially relative to a center of the substrate support when the substrate support moves between a raised position and a lowered position;

a second end of each lever positioned below a second side of the substrate support and adapted to engage the bottom of the chamber body when the substrate is in a lowered position, the second end comprising a roller;

a ramp coupled to the bottom of the chamber body, the ramp being adapted to engage the rollers to urge the first ends of the at least three levers radially outward relative to a center of the substrate support;

a plurality of lift pin holes disposed through the substrate support, said lift pins holes being positioned radially inward of the at least three levers;

a plurality of lift pins disposed through the plurality of lift pin holes, each lift pin comprising a first end adapted for supporting a substrate thereon and a second end extending below the second side of the substrate support; and

a lift plate positioned beneath and substantially parallel to the substrate support, adapted for contacting the second ends of the plurality of lift pins and urging the plurality of lift pins upward through the plurality of lift pin holes in the substrate support, wherein the lift plate comprises at least three apertures, each aperture positioned substantially beneath one of the at least three levers, to allow the second ends of the at least three levers to pass therethrough.

21. A substrate centering apparatus comprising:

a chamber body having a bottom;

a vertically moveable substrate support disposed in the chamber body and having a first side adapted to support a substrate during processing;

at least three levers movably coupled to the substrate support in a spaced-apart relation proximate a perimeter of the substrate support;

a first end of each lever extending beyond the first side of the substrate support, the first end adapted to engage an edge of the substrate and adapted to be displaced radially relative to a center of the substrate support when the substrate support moves between a raised position and a lowered position;

a second end of each lever positioned below a second side of the substrate support and adapted to engage the bottom of the chamber body when the substrate is in a lowered position, the second end coupled to a roller;

at least three rails disposed on the second side of the substrate support, said rails extending along at least a portion of a radius of the substrate support;

at least three linear slides adapted to slidably engage the at least three rails, each of the at least three linear slides being coupled to one of the at least three levers; and

a ramp coupled to the bottom of the chamber body, the ramp being adapted to engage the rollers to urge the first ends of the at least three levers radially outward relative to a center of the substrate support.

22. A substrate centering apparatus comprising:

a chamber body having a bottom;

a vertically moveable substrate support disposed in the chamber body and having a first side adapted to support a substrate during processing;

at least one moveable element movably coupled to the substrate support in a spaced-apart relation proximate a perimeter of the substrate support;

at least two fixed elements projecting upward from the first side of the substrate support and positioned for engaging edges of a substrate substantially centered thereon;

a first end of each moveable element extending beyond the first side of the substrate support, the first end adapted to engage an edge of the substrate; and

a second end of each moveable element positioned below a second side of the substrate support and adapted to engage the bottom of the chamber body when the substrate is in a lowered position.